Semi-annual Report, July to December 2002
University of Arizona/ NAS5-31364
A. Huete

1. TASK OBJECTIVES

During the second half of 2002, our tasks were primarily associated with the following:

1) Complete collection 4 reprocessing
2) Evaluation of pre-collection 4 test data
3) Continue evaluating MODIS-Aqua VI data stream
4) Start the generation of a 3 year added value global MODIS data archive
5) Coordination tasks with the MODLAND group
6) Evaluation of MODIS long term, daily VI data series over the Amazon
7) Evaluate the status of MODIS VI validation
8) Conducted validation campaigns in Brazil and the Southwest USA
9) MODIS VI product quality assurance processing and application
10) Short course on MODIS VI's given in Copenhagen

2. WORK ACCOMPLISHED

2.1 Algorithm and Code development, maintenance, and enhancements

The specific accomplishments during the second half of 2002 were:

- MODIS VI 1km, 500m, and 250m algorithms were tested and modified to meet the deadline for collection 4
- Science changes were made to properly handle the new upstream QA data structure
- Production of a simplified global MODIS VI data set and VI maps
- Analysis of the Caspian Sea NDVI problem
- Participation in the MODIS surface reflectance workshop
- Comparison of Terra and Aqua VI product
- Addressed the spatial artifacts and anomalies in MOD13Q1 and MOD13A1,
- MODIS VI compositing research,
- SCF maintenance and in-house code development

During the second half of 2002 we delivered new versions of all MODIS VI Algorithms, including:

a. MOD13A1, MOD13A2, and MOD13A3 Version 3.0.0
b. MODAGG Version 3.0.0
c. MOD13Q1 Version 3.0.0

A major change was to accommodate the change from ISINUS to the SINUS projection and associated upstream changes in the QA data structure. These changes were made mostly to enable the algorithms to ingest the cirrus bit.

Collection 4 deliveries were made in September and October, 2002. In preparation for collection 4 reprocessing the MODIS team performed four evaluation tests prior to the official start of reprocessing. The MODIS team also decided to adopt the Sinus projection and no longer use the Integerized Sinus projection. This modification required minor changes to all algorithms. We also made some minimal changes to our algorithms to accommodate another set of upstream changes. Level-2 and Level-2G products and algorithms modified some of the quality data structure in the files and thus all downstream products needed modifications to accommodate this. An SCF internal test was conducted prior to delivering the new algorithms and the results appeared very promising. In preparation for collection 4 reprocessing the MODIS team held a daylong telecon and every team presented their changes and expected improvements.

2.2 Global data set production

In order to reach a larger community we internally reproduced three years of MODIS 1km VI in a simpler projection and format. This task was carried out to insure broader access to the MODIS VI data record by scientists who have difficulties with the current data structure and format. This global data set is designed to simplify the data format and projection so as to meet a variety of community needs. We completed assembling the year 2000 data set and have started producing years 2001 and 2002. The entire 3-year data set should be ready by the end of spring 2003. In doing this, we decided to produce value added products as well, like the Maximum NDVI/EVI and derivative NDVI/EVI. We already have made this data available to scientists working on global change and climate modeling. Along with this effort we continue to cooperate with the global change and climate modeling community by providing MODIS VI data and expertise. In a similar effort we started a project for drought assessment and food security using MODIS VI data in cooperation with many research institutes. Figure 1 shows example images of this product.

Global EVI Spring 2000 *Global EVI Summer 2000*

Global EVI Fall 2000 *Global EVI Winter 2000*

Figure 1: Global Seasonal MODIS EVI for year 2002

2.3 SCF Maintenance

a. System upgrade and maintenance, our SGI system is now running IRIX 6.5.16
b. In house code development to serves several MODIS VI and research purposes:
c. Installed the newest version of MODIS Reprojection Tool, which is now able to project and stitch multiple MODFIS tiles.
d. Purchase of more disk space, which should go online very soon.
e. Ordering, processing, backup MODIS VI data including 1km, 500m, 250m, and input data of core sites. For both Terra and Aqua, the data flow is around 180G bi-week.
f. Creating, maintaining and modifying MODIS data processing tools, which includes code producing tile quick images, core sites data subsetting in ASCII and HDF formats, and global mosaics.
g. Administration of MODIS VI database in TBRS, which record and manage MODIS data and support web search engine interface.
h. Setup and administer anonymous ftp server which supplies VI data needed by those outside the TBRS lab.
i. System administration of the host of servers, including writing of a new firewall, installation IDS. and maintaining Samba server for the data flow between PCs and SGI machines.

2.4 MODIS VI Product Evaluation

2.4.1 NDVI and EVI seasonal change in the Amazon region

We evaluated a three-year, daily MODIS VI dataset over the Tapajos region in the Amazon to assess MODIS VI capabilities in depicting seasonal changes in this dense forest region that is normally contaminated with clouds. A new daily compositing algorithm was designed and 900 days worth of data processed using this specialized algorithm. The results are shown in following figures.

Figure 2: Location of the extracted data

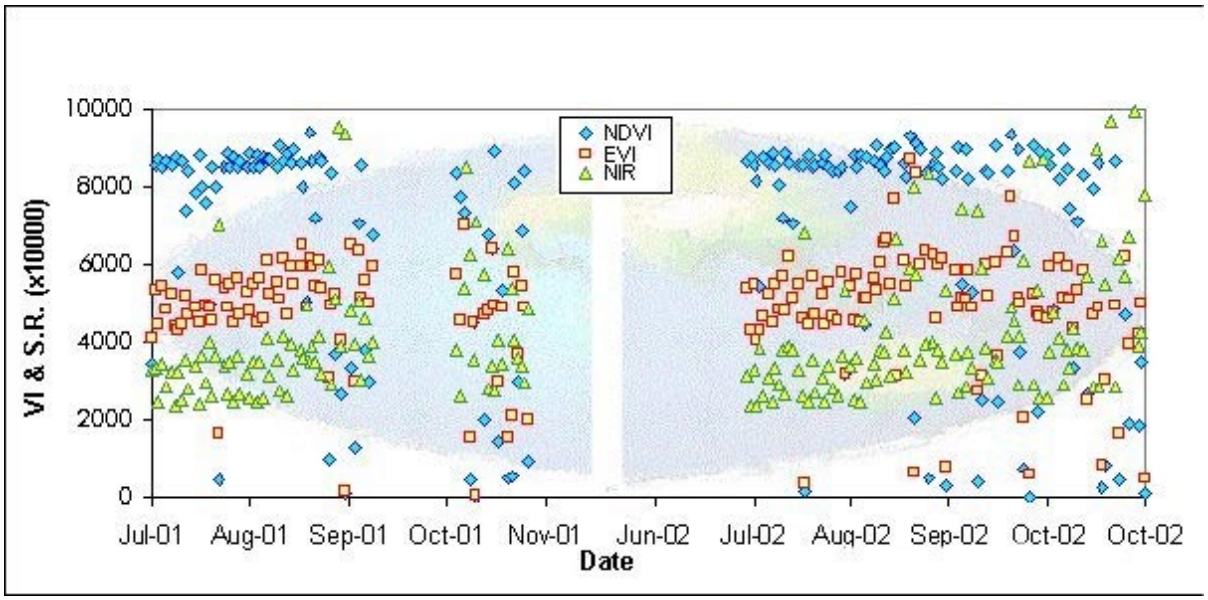


Figure 3: MODIS NDVI and EVI daily seasonal profiles for the Tapajos region during the dry season period (Site A. – a less cloudy site - based on extracted data from Figure 2). This figure illustrates the EVI capabilities in depicting seasonal change when NDVI is almost stable

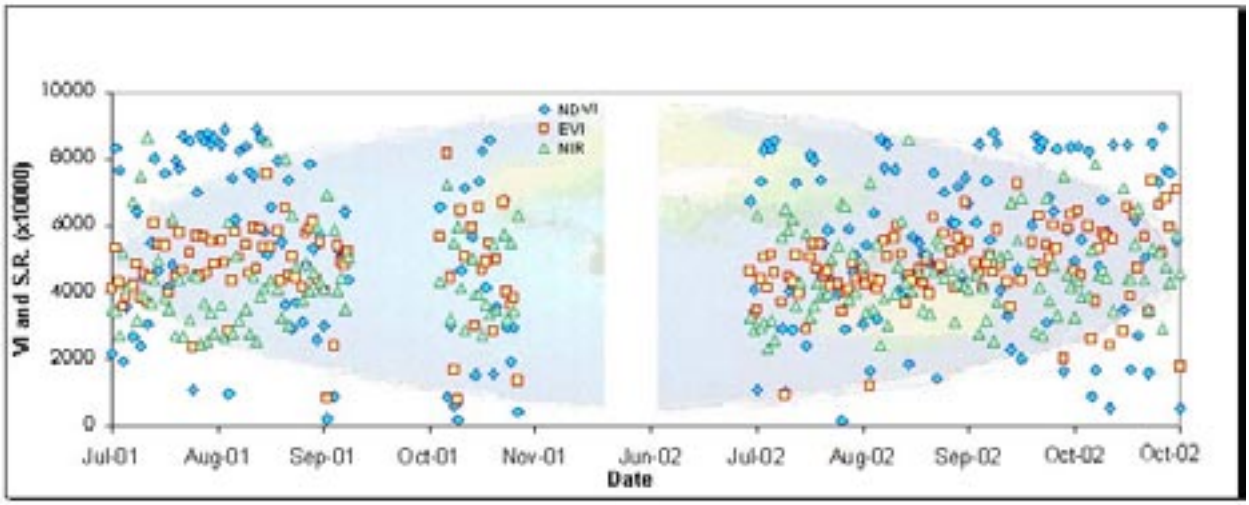


Figure 4: MODIS NDVI and EVI daily seasonal profiles for the Tapajos region. Second location, this site is cloudier. EVI depicts an increase in vegetation activities, and NDVI is almost stable and noisier.

An interesting outcome of this study was that the EVI results, as well as the NIR reflectances, increased in values following the onset of the dry season. This "NIR flush" is attributed to the sudden appearance of solar radiation and the dropping of older leaves and flush in new leaf growth activity.

2.4.2 MODIS VI analysis over the Caspian Sea

Our team was alerted to an anomaly of the MODIS NDVI over the Caspian Sea by the Land Surface Temperature team, where they noticed unusually high NDVI values (Figure 5). To investigate this anomaly we downloaded multiple daily surface reflectance data and performed an in-house test to investigate the source. Our analysis indicated that the L2 surface reflectance product algorithm was over correcting the data over the water leading to unusually high NDVI values. In Figures 6, 7, we display transects over water in the Caspian Sea to show the surface reflectance relationships.

NDVI is very sensitive to the difference between the NIR and Red bands, and since the surface reflectance algorithm is overcorrecting these bands over water, the results yield very small surface reflectance values in the red band in relation to the NIR and Blue bands, producing very high NDVI values. The surface reflectance algorithm team was notified and they will look at the problem. For now, and since these anomalies only occur over water the problem is not considered serious to warrant immediate action from them.

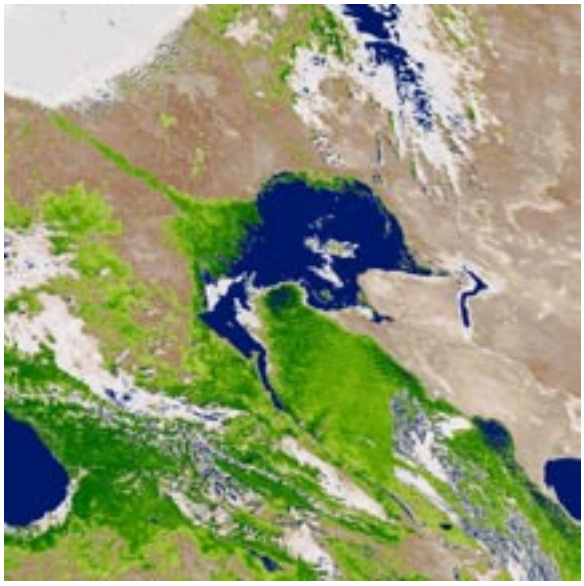


Figure 5: High NDVI values over the Caspian Sea

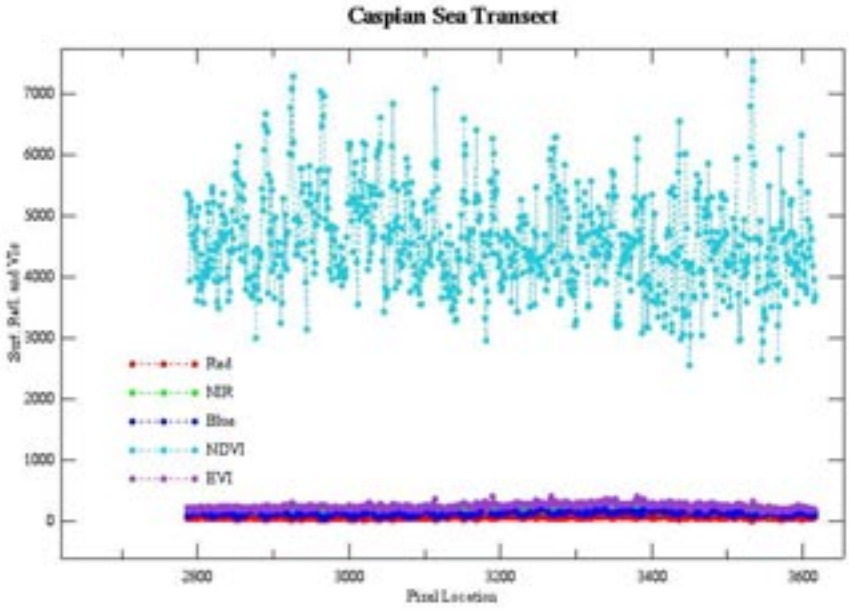


Figure 6: Transect over water in the Caspian Sea. NDVI is unusually very high.

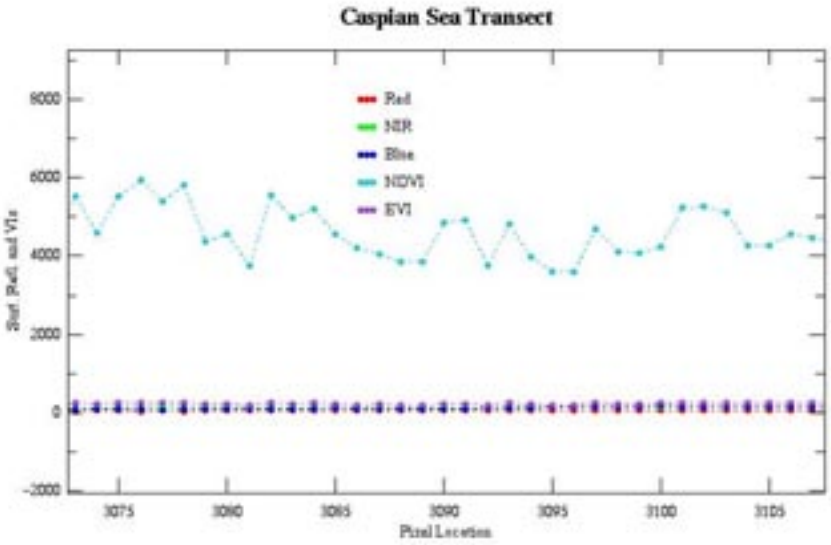
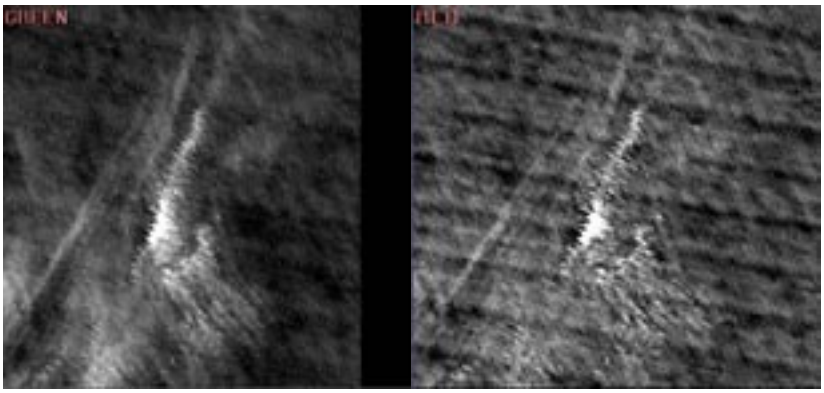


Figure 7: Transect over water in the Caspian Sea. NDVI is unusually very high.



NIR band Red Band

Figure 8: Surface reflectance bands over water in the Caspian Sea.

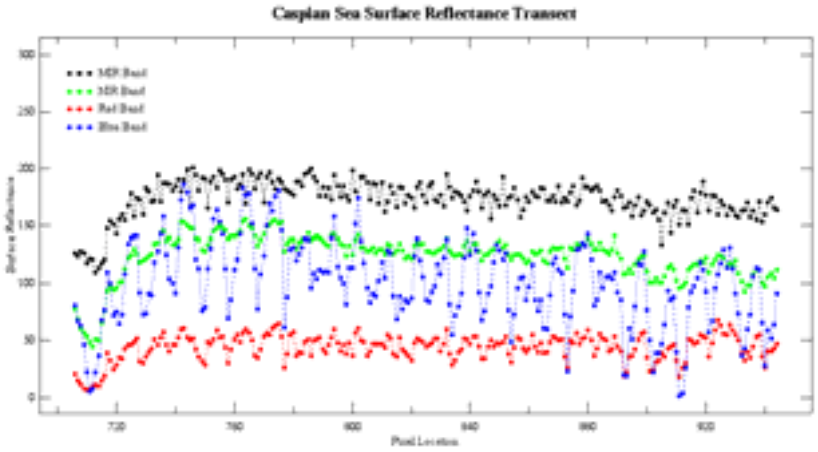
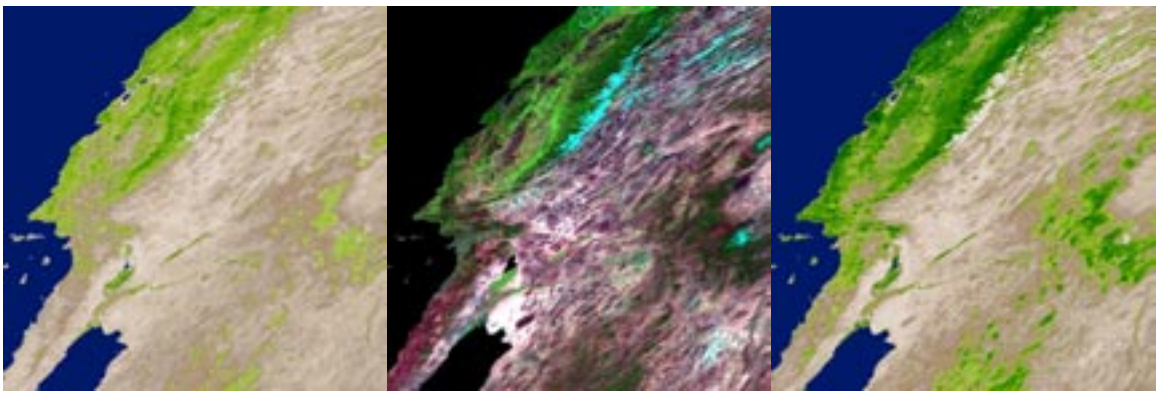


Figure 9: Surface Reflectance transect over water in the Caspian Sea. The red band is unusually low in proportion to the Red and Blue bands.

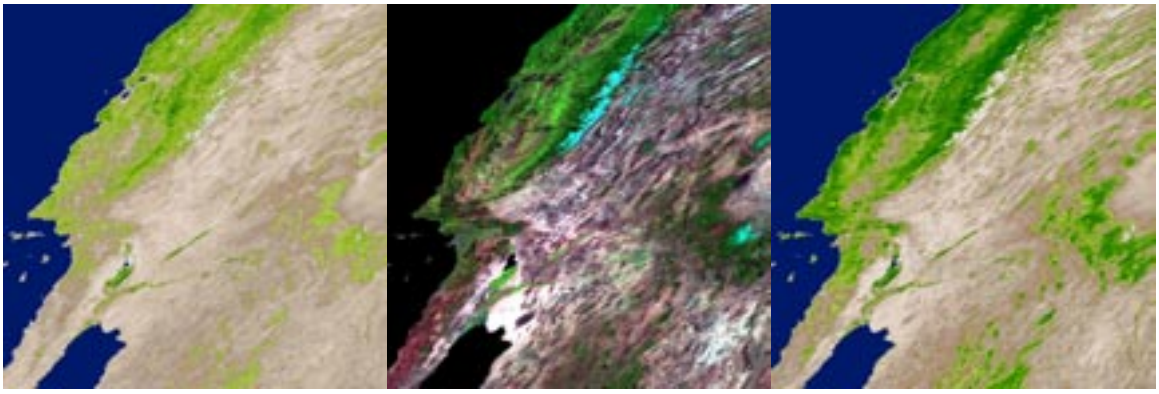
2.4.3 Terra and Aqua MODIS VI Comparisons

We continue to evaluate the differences between Terra and Aqua VI product and understand these differences. In order for the MODIS VI to be robust and useful, both Terra and Aqua platform products should be similar. Terra and Aqua products are very stable now and should be comparable, as the differences should be minimal and only be related to variable atmosphere or viewing angles.

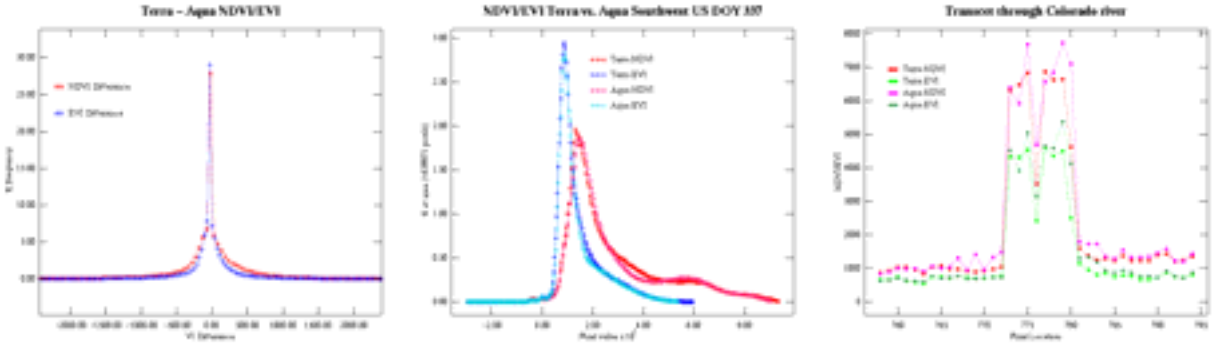
We conducted a comparison between the two products in order to understand their relationships and differences. For this exercise, data from different locations were used to compare NDVI, EVI and the composited surface reflectances. The following series of figures illustrate these comparisons.



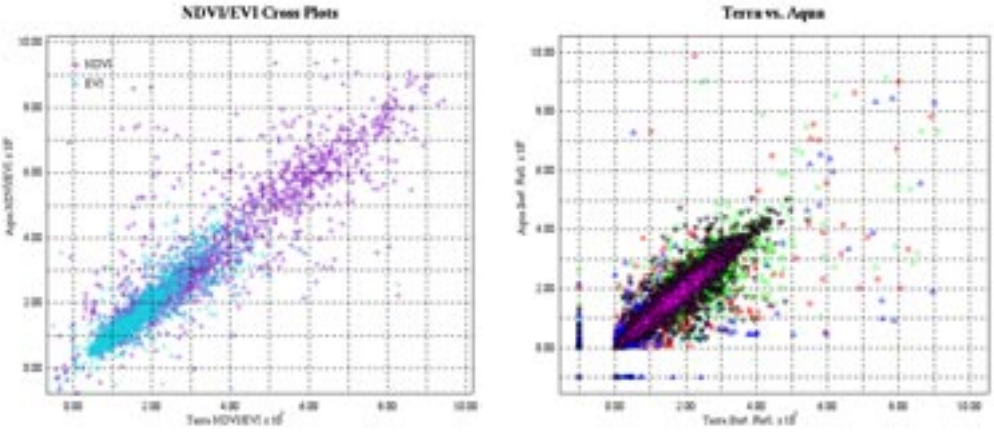
Terra MODIS EVI MIR/NIR/Red NDVI



Aqua MODIS EVI MIR/NIR/Red NDVI



Terra/Aqua differences Terra/Aqua VI histograms Terra vs. Aqua transects



VIs Terra vs. Aqua Surf. Refl. Terra vs. Aqua

Figure 10: Comparison of Terra and Aqua VI products

All analysis indicate that the MODIS VI product for both Terra and Aqua are identical except for a few differences that could easily be attributed to cloud cover differences between the two overpasses or sun and viewing angle differences. Overall both products are linearly

correlated and could be interchanged when used. Aqua did overcome the stripping problem noted for Terra.

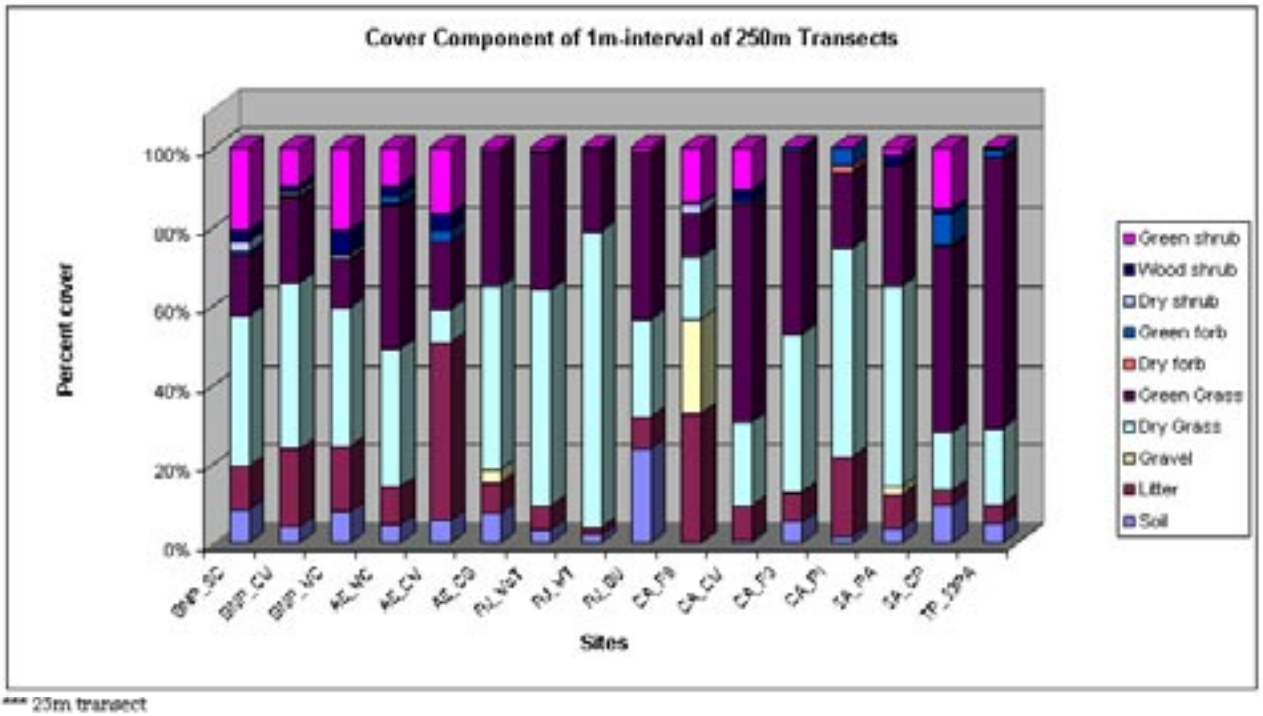
2.5 Validation Activities

All MODIS VI products are still set to provisionally validated status (Level-1), but we plan to soon upgrade this status to fully validated at the end of the collection 4 reprocessing. We conducted two major validation efforts in the second half of last year, an LBA field campaign and a joint U.S. – Japan helicopter experiment.

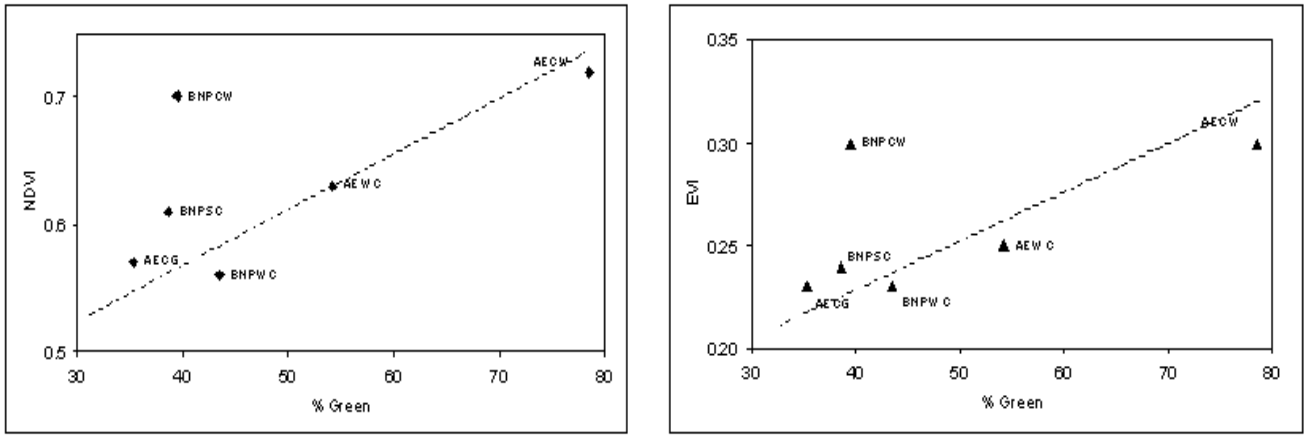
2.5.1 MODIS-LBA field campaign:

The Brazil field campaign was from June 10 to July 21, 2002. We extracted MODIS VI seasonal data and conducted quality assessments (QA) and filtering. 16 field transects were measured for vegetation and soil cover components. Our graduate student, Piyachat Ratana, is summarizing the cover component data and generating plots and analysis. She has delineated all transect locations overlain onto Landsat-7 ETM+ by using GIS.

The transects were located in three main areas: Brasilia National Park, Palmas, and Tapajos. There are 16 transects; 3 transects in Brasilia National Park (BNP), 3 transects in Aguas Emendatus (AE), 3 transects in Rio de Janeiro (RJ), 4 transects in Cangusu (CA), and 2 transects in Santana Araguaia (SA) and 1 transect in Tapajos (Tp). The main land cover types of the study sites are Cerrado woodland, Wooded cerrado, Shrub cerrado, Cerrado grassland, and Pasture. We are characterizing the radiometric and biophysical properties of these land cover types. The relationship of biophysical (cover component, Leave Area Index (LAI), fraction of Photosynthetically Active Radiation (fPAR), soil data) and optical properties (vegetation indices) are being analyzed. Samples of the dataset are provided below.



*** 25m transect



The relationship of green cover component Brazil field data and MODIS NDVI and EVI at the same composite period of field measurement

We utilized the Terra- Moderate Resolution Imaging Spectroradiometer (MODIS) Vegetation Index (VI) products and quality assurance information (QA) to analyze the seasonal and spatial patterns of photosynthetically-active vegetation activity over an eco-climatic gradient extending from the diverse Brazilian cerrado region to the seasonal tropical forest (Tapajos National Forest). The MODIS-VI seasonal profiles for 2000, 2001, and part of the 2002 exhibited very pronounced dry and wet periods in the cerrado region with vegetation dynamics lagging precipitation by 1 month. We observed decreasing dry-wet seasonal patterns in the transitional (cerrado/ forest) areas near Araguaia National Park. In contrast, the seasonal behavior of the tropical forests at Tapajos were harder to assess, but showed increasing enhanced vegetation index (EVI) values during the dry season (July – November). This was attributed to the flush of new new leaf growth during the dry season and was accompanied by a marked rise in near-infrared reflectances.

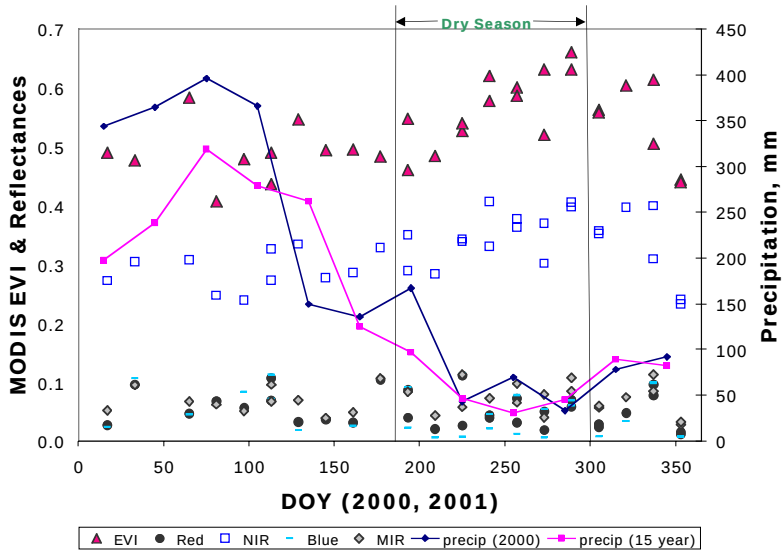


Figure 11. MODIS generated seasonal profiles for the Tapajos study site.

We also compared this with a 20-year average NDVI/ AVHRR-Pathfinder data set with rainfall from Brasilia to Tapajos (Figure 12). We used 20 years of monthly NDVI data from AVHRR satellite (8km resolution) to determine the minimum, mean and maximum seasonal cycle of average-aggregated NDVI covering the eco-climatic Brazilian transect for the period of September 1981-2001. From Brasilia to Tapajós were computed 24 points, which are related to the 24 transects that will be used as reference for the AVIRIS Flight lines (TBRS field work /2003). For each point (one transect AVIRIS) on the graphic used, the NDVI values represent an average of 20 values NDVI for a particular month in the 1981-2001 periods. For example, each NDVI value applicable to the minimum, mean, and maximum for the month of January was based on 20 values obtained in 1981-2001 using the same methodology from February to December. The 24 points used for the NDVI/AVHRR transect represent the 24-AVIRIS Flight transects from point #1 NDVI/AVHRR (Brasilia) to point #24 NDVI/AVHRR (Tapajós).

There were 3 gradients observable, the first gradient increases from point #1 to point #9, the second gradient from point #10 to #11, and the third gradient from point #14 to #24. The spatial variability of the NDVI/AVHRR transect (from point #1 to point #24) follows the same spatial pattern from January to December, being differentiated by the intensity of NDVI values being maximum between May and June and minimum between September and October. The minimum, mean, and maximum NDVI seasonal curves have the same spatial variability from Brasilia to Tapajós.

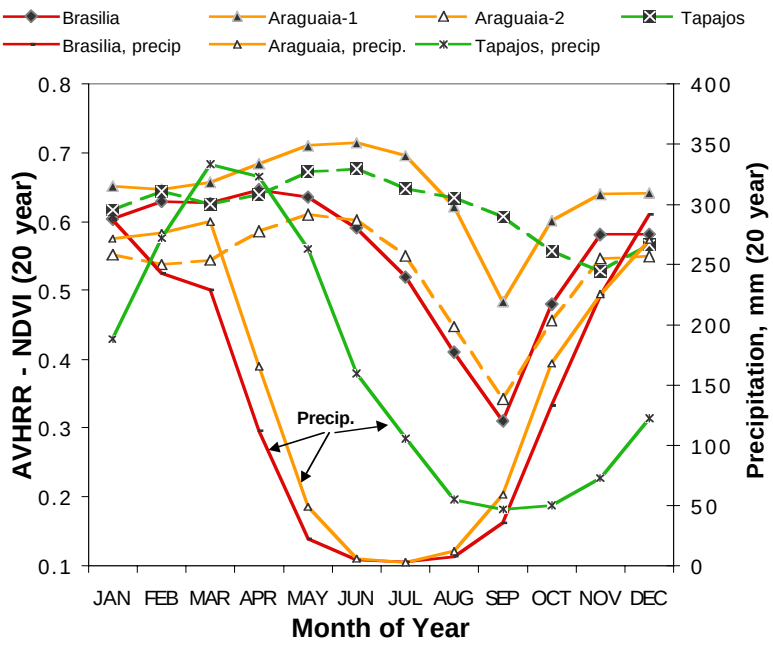


Figure 12. 20 year average NDVI and precipitation data record for an eco-climatic transect from the cerrado region near Brasilia to the seasonal rainforest near Tapajos National Forest.

2.5.2 MODIS-GLI helicopter campaign:

During the summer we cooperated with the Japanese Chiba University team in a field campaign over a large section of the Southwest, from the Colorado River region near Yuma through the Santa Rita Experimental Range and Walnut Gulch Experimental Watershed and finally to the Jornada Experimental Range near Las Cruces, New Mexico. The results of this campaign are being used to validate both MODIS Terra and Aqua and are a precursor to the GLI validation activities. The GLI MODIS coordination is still on going. In December 2002, the ADEOS platform with GLI sensor successfully was launched and the projected data for turning on the GLI instrument will be on around the 20th January.

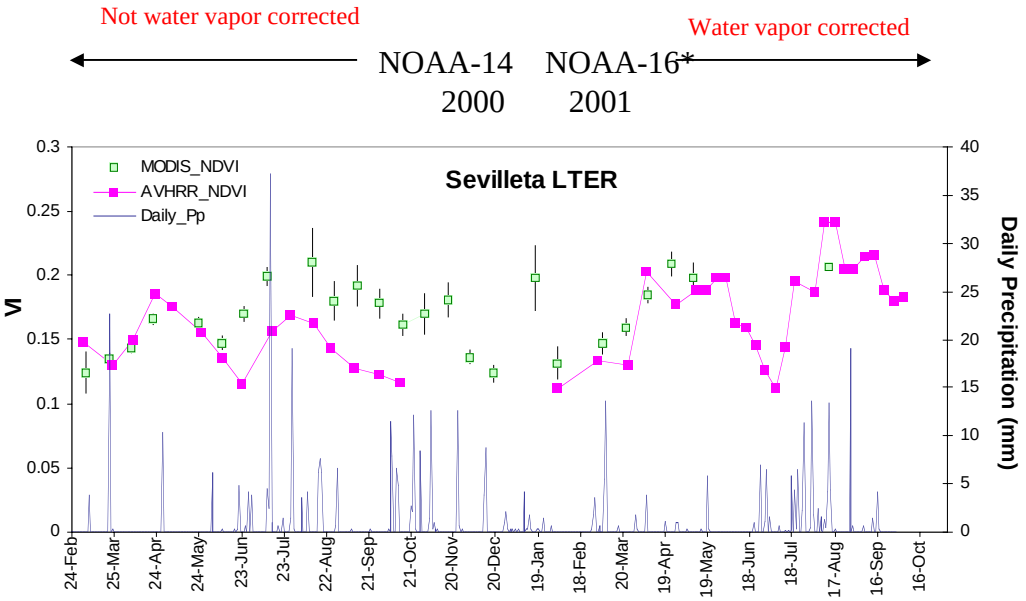
2.6 MODIS VI Continuity:

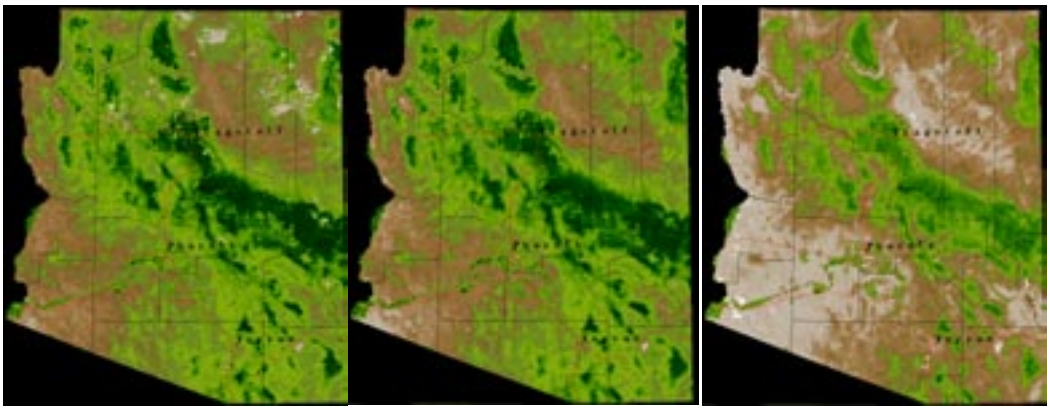
2.6.1 NASA Proposal

Our proposal for 'continuity studies' was given good ratings but not funded. The proposal was submitted in response to NASA NRA-01-OES-06 "Ecological Research in the Large-Scale Biosphere-Atmosphere Experiment in Amazônia (LBA-ECO): Phase II, ***and Opportunities in Terrestrial Ecology***". The proposal was entitled: "Multi-sensor Calibration of Vegetation Indices for Continuity and Time Series Studies on Ecosystem Variability and Responses" by: Dr. Tomoaki Miura (P.I.), Alfredo Huete as co-investigator along with Dr. Hiroki Yoshioka of Aichi Prefectural University, Aichi 480-1198, Japan, and Dr. Christopher Potter of the Ecosystem Science and Technology Branch, NASA Ames Research Center as collaborator.

2.6.2 ***MODIS- NOAA-14, and NOAA-16.***

In conjunction with Dr. Wim van Leeuwen, of the Arizona Remote Sensing Center, we have been investigating some of the VI continuity issues.





MODIS (Terra)	**AVHRR-16**	**AVHRR-16**
(Nov 19 - Dec 2, 2001)	(Nov 16-29, 2001)	(Nov 16-29, 2001)
Atmospherically corrected	H_2O corrected	Non-H_2O corrected

2.7 Outreach Activities

2.7.1 MODIS Outreach Workshop on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), July 15-19th 2002, University of Montana, Missoula, MT.

The CD version of the outreach workshop was posted on the MODIS "What's New" section and we received many comments and interest. The CD version covers the basics and mechanics of the MODIS Vegetation Index Products and their role within the MODIS instrument land product stream. We discuss the vegetation index algorithm, the VI products, their quality assessment (QA) parameters with both input and output considerations, and the generation of multitemporal seasonal profiles.

The contents of the CD as well as sample MODIS VI datasets can be found at:

http://tbrs.arizona.edu/modvegwkshp/Index.html

CD Main menu
Introduction
VI Algorithm
VI Products

VI QA
VI Status
Sample Data
VI Data
Sample VI Profiles
Sample VI Tools
Miscellaneous
VI FAQ

2.7.2 MODIS Workshop on Land Surface Radiation Budget Variables and Snow and Ice products. Boston, MA. October 2002.

The MODIS team held a surface reflectance and radiation budget workshop at Boston University (Boston, MA) to promote and showcase a set of MODIS products. The workshop was designed to showcase MODIS products and validation effort. We participated in this workshop with two posters about the MODIS VI product and our joint validation campaign with the Japanese Chiba University team. Kamel Didan also gave an oral presentation about our validation effort with the Japanese remote controlled helicopter summer campaign in the Southwest.

2.7.3 MODIS VI Tutorial in Copenhagen, Denmark

Alfredo Huete gave a one-day MODIS VI tutorial at the Institute of Geography, University of Copenhagen, as part of a PhD Course entitled "Remote Sensing, new sensors, new methods", Copenhagen, 9. -13. December 2002. The teachers for this course were; Alfredo Huete, University of Arizona; Henrik Steen Andersen, Danish Meteorological Institute; Niels Broge, (agrsci); Henning Skriver, EMI; Michael Schultz Rasmussen, GI; Birger Ulf Hansen, GI; Kjeld Rasmussen, GI; Eva Bøgh, GI; Inge Sandholt, GI. The material presented was an expanded version of the Montana Vegetation Outreach Workshop in July – but was limited to discussion of the MODIS Vegetation Indices.

2.8 Publications

Huete, A., Didan, K., Miura, T., and Rodriguez, E., 2002, Overview of the radiometric and biophysical performance of the MODIS vegetation indices, Special Issue, *Remote Sens. Environ*. 83:195-213

Wang Zheng-Xing, Liu Chuang, Huete Alfredo, 2002, "From AVHRR-NDVI to MODIS-EVI: advances in vegetation index research", *Acta Ecologica Sinica*, (in press).

Ferreira, L.G. and Huete, A.R., 2002, Assessing the seasonal dynamics of the Brazilian Cerrado vegetation through the use of spectral vegetation indices, *International Journal of Remote Sensing* (in press).

Ferreira, L.G., Yoshioka, H., Huete, A., and Sano, E., 2002, The seasonal response of spectral vegetation indices in the Brazilian Cerrado: an analysis within the large scale biopshere-atmosphere experiment in Amazonia, Remote Sens. Environ. (in press).

Ferreira, L.G., Yoshioka, H., Huete, A., and Sano, E., 2002, Optical characterization of the Brazilian savanna physiognomies for improved land cover monitoring of the cerrado biome: Preliminary assessments from an airborne campaign over an LBA core site, *Journal of Arid Environments* (in press).

Zhang, X., Friedl, M.A., Schaaf, C.B., Strahler, A.H., Hodges, J.C.F., Gao, F., Reed, B.C., Huete, A., 2002, Monitoring Vegetation Phenology Using MODIS, *Remote Sens. Environ.*, (in press)

Gao, X., Huete, A.R., and Didan, K, 2002, Multi-sensor comparisons and validation of MODIS vegetation indices at the semiarid Jornada Experimental Range, *IEEE Trans. Geosc. and Remote Sensing* (in press).

Yoshioka, H., Miura, T., and Huete, A.R., 2002, Isoline-based translation technique of spectral vegetation index using EO-1 Hyperion data, *IEEE Trans. Geosc. and Remote Sensing* (in revision).

2.9 Symposia and Conferences

MODIS Meeting (July 22-24 2002)

Huete, A., Didan, K., Ratana, P., Ferreira, L., Shimabokuro, Y., Miura, T., and Gao, X., 2002, "Seasonal Variability Studies Across the Amazon Basin with MODIS Vegetation Indices ", presented at the MODIS Science Team Meeting, Greenbelt, Maryland , July 22-24.

Invited Presentations

Huete, A., Yoshioka, Y., Miura, T., Didan, K., and Rodriguez, E.P., 2002, "Inter-Sensor Calibration of Vegetation Indices for Synergistic Monitoring and Continuity Studies of Ecosystem Variability ", presented at the First International Symposium on "Recent Advances In Quantitative Remote Sensing", Torrent, Spain, 16-20 September.

Huete, A.R., Didan, K., Ratana, P., Ferreira, L., 2002, "Seasonal Biophysical Dynamics of the Amazon from Space Using MODIS Vegetation Indices", presented at the American Geophysical Union Fall Meeting, Special session on LBA research, San Francisco, CA, December 6-10, 2002.

Huete, A. , Ratana, P., Ferreira, L., Shimabukuro, Y., Didan, K., and Miura, T., 2002, "A Look at Amazon Basin Seasonal Dynamics with the Biophysical Products from the Terra-MODIS Sensor", presented at the Second International LBA Scientific Conference, Manaus, Brazil, July 7-10.

Ferreira, L., and Huete, A.R., 2002," Monitoring The Spatial And Temporal Dynamics of The Brazilian Cerrado Physiognomies With Spectral Vegetation Indices: An Assessment Within The Large Scale Biosphere-Atmosphere Experiment In Amazonia (LBA)", presented at the Second International LBA Scientific Conference, Manaus, Brazil, July 7-10.

Ferreira, L., Sano, E.E., and Huete, A.R., 2002, "The Potential of Combined SAR Data and Optical VI´s for Vegetation Mapping in the Brazilian Cerrado", presented at the Second International LBA Scientific Conference, Manaus, Brazil, July 7-10.

Huete, A., Miura, T., Didan, K., Ferreira, L., Sano, E., Shimabukuro, Y., Bustamante, M., and Klink, C., 2002, "Use of Airborne Remote Sensing for Uncertainty Assessments in Regional Extrapolations of Ground LBA Ecology Measurements with MODIS Data", presented at the Airborne Remote Sensing Post-Conference Workshop, Manaus, Brazil, July 11-12.

Huete, A., et al., 2002, "MODIS Vegetation Indices (MOD13)", Presented at the MODIS Outreach on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), July 15-18, University of Montana, Missoula, MT.

Didan, K., Gao, X., and Huete, A., 2002, "MODIS Vegetation Index Quality Assurance Processing and Application", Presented at the MODIS Outreach on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), July 15-18, University of Montana, Missoula, MT.

Gao, X., Huete, A., Schaub, D., Ferreira, L., Miura, T., Didan, K., 2002, "Global Validation of EOS-MODIS Vegetation Indices", Presented at the MODIS Outreach on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), July 15-18, University of Montana, Missoula, MT (Poster).

Rodriguez, E.P., Huete, A.R., Schaub, D., Didan, K., Miura, T., Glenn, E., and Nagler, P., 2002, "Application of MODIS Vegetation Indices to Monitor Seasonal Responses and Water Use Impacts over the Colorado River Delta Area, Mexico", Presented at the MODIS Outreach on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), July 15-18, University of Montana, Missoula, MT.

Morisette, J., Vernote, E., Huete, A., Privette, J., and Roy, D., 2002, "Validation Analysis, Continuous Land Product Example: NDVI", Presented at the MODIS Outreach on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), July 15-18, University of Montana, Missoula, MT (Poster).

Didan, K., Huete, A., et al., 2002, USA Remote-Controlled Helicopter Campaign. Oral presentation at the Boston MODIS workshop. October 2002.

Didan, K. et al., 2002, MODIS Vegetation Index Product series. Poster presented at the Boston MODIS workshop, October 2002.

3. Future Activities for the next 6 months (Jan. – June 2003)

3.1 The following tasks are in order of importance:

- Complete the update to the MODIS User's Guide for our product
- A more rigorous validation assessment is planned of the VI's.
- Submission of NRA for continued algorithm work
- Submission of NRA for Earth Science applications.
- Possible submission to NPOESS NRA for VI bridging studies from MODIS to NPOESS (VIIRS)
- Evaluation of Collection 4 reprocessed data prior to public release
- Global MODIS VI 1km data set
- MODIS VI Climate Modeling Grid and IDS algorithm

3.2 Future Meetings and Seminars (6 months)

- February 11th. A. Huete will give an invited talk to the Ecology Department at the University of Chicago, Illinois (UCI) campus. The topic will cover the application of MODIS data to ecophysiological studies.

- February 26-28. A. Huete and T. Miura will attend the AVIRIS/ Hyperion Workshop in Pasadena, CA and give presentations. A. Huete will give a talk on the use of Hyperion data in inter-sensor calibration of vegetation indices from MODIS to other sensors.

- March 12 –14. A. Huete will give an invited talk at the U.S. EPA Spectral Remote Sensing Conference, Las Vegas, NE. The subject of the talk will deal with MODIS continuity issues.

- April 5-6. We will conduct a special MODIS workshop in Belo Horizante, Brazil, prior to the XI Brazil Symposium on Remote Sensing. The workshop is a tutorial based on the public outreach workshop held in Montana in July 2002, and is entitled: Applications of the MODIS "Land" products for vegetation mapping and environmental monitoring.

- April 7-11. A. Huete, T. Miura and two graduate students will present papers at the XI Brazil Symposium on Remote Sensing. These papers are related to the use of MODIS data in the cerrado, caatinga, and rainforest biomes in Brazil.

- May 15-30. An AVIRIS campaign is scheduled to fly our eco-climatic transect from the Barzilian cerrado to the forest near Tapajos National Forest in the Amazon. The objective of this campaign is to validate MODIS Aqua and Terra VI products and surface reflectances through field scaling studies via the AVIRIS 5m pixel size.

3.3 Hawaii Proposal

We put together some basic ideas for drought monitoring and provided a drought section to a proposal that was submitted by the Pacific Disaster Center in Hawaii. The proposal is entitled "**An Interactive Asia-Pacific Natural Hazards and Vulnerabilities Atlas:**

Incorporating Dynamic Flood, Fire and Drought Warnings and Indications". If the project is accepted, we will collect and analyze MODIS and AVHRR satellite data over southeast Asia as input into measures for assessments and monitoring of drought.

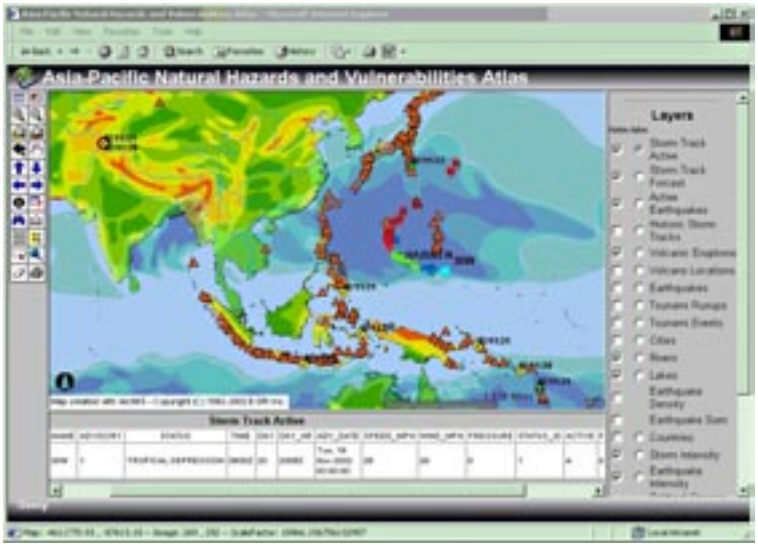


Figure 1. The Asia-Pacific Natural Hazards and Vulnerabilities Atlas provides an integrated analysis environment for assessing potential impact of hazard events on people and resources in the region within the context of historical hazards.